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(54) **Method for managing a network when master disappears**

Verfahren zur Netzverwaltung bei Wegfall eines Masters

Procédé pour la gestion d'un réseau quand le maître disparait

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(73) Proprietor: **SAMSUNG ELECTRONICS CO., LTD.**
Suwon-City, Kyungki-do (KR)

(72) Inventors:
- **Choi, Joon-bo**
  Bundang-gu, Sungnam-city, Kyungki-do (KR)
- **Kang, Woo-shik,**
  422-1603, Kunyoung Apartment
  Suwon-city, Kyungki-do (KR)

(74) Representative: **Chugg, David John et al**
Appleyard Lees,
15 Clare Road
Halifax, West Yorkshire HX1 2HY (GB)

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Description

[0001] The present invention relates to a method for managing a network in which Bluetooth equipped devices are linked together, and more particularly, to a method for managing a network by a backup master when the master of the network cannot serve as a master in the network operating region.

[0002] Bluetooth technology relates to a wireless communications method having no centralized control function, in which wireless transmission and reception of data between Bluetooth equipped devices are established in a local area, without cables. Although one-to-one or one-to-multi connection can be established, due to the lack of the centralized control function, the Bluetooth technology has not been applied in a network. To manage Bluetooth equipped devices in a network, one of the Bluetooth equipped devices must be designated as a master of the network, i.e., the Bluetooth piconet.

[0003] Referring to Figures 1 and 2, in a conventional method for designating a master and slaves in a network in which a plurality of Bluetooth equipped devices are linked together, when power is applied to a Bluetooth equipped device, a network manager 160 of the Bluetooth equipped device inquires as to whether any Bluetooth equipped device exists within a radio coverage region (S212). The network manager 160 determines whether the response from any Bluetooth equipped device is detected (S214). The network manager 160 of the Bluetooth equipped device, to which power is applied, serves as the master or a slave of the network according to whether there is a response or not in step S214. In particular, if there is no response to the inquiry in step S214, the network manager 160 sets a master mode, and performs inquiry scan (S216) and page scan (S218). The network manager 160 chosen as the network master checks whether any Bluetooth equipped device attempts to establish a connection (S220). If yes, the network manager 160 accepts the request for connection, and requests the Bluetooth equipped device, which requests connection, to change its role to a slave, while the network manager 160 remains as the master of the network (S222). Then, the network manager 160 transfers information on itself, as the network master, and information on other slaves, to the new slave linked to the network. The network manager 160 also stores information on new slaves or the slaves which have left the network, such as addresses or names of the slaves, and announces the stored information to the other slaves linked to each other throughout the network (S224).

[0004] Meanwhile, in step S220, if there is no connection request from any Bluetooth equipped device, a determination as to whether to change the mode is made (step S226). The mode can be changed when a user wants to modify a role of the Bluetooth equipped device from the master to a slave, when the Bluetooth function is switched off, or when power is turned off. If it is determined in step S226 to keep the master mode, the process returns to step S216 to continue its role as the network master. In contrast, if it is determined in step S226 to change the mode, the master mode is expired.

[0005] Meanwhile, in step S214, if a response to the inquiry is detected in step S214, this means that a pre-existing network exists within the radio coverage region. In this case, in order to enter the pre-existing Network, the network manager 160 pages the master of the pre-existing Network to establish a connection (S232). If the connection is established, the network manager 160 changes its role to a slave with respect to the master of the pre-existing network (S234). Next, the network manager 160 receives information on the other slaves of the pre-existing network from the network master (S236), thereby terminating the designation of master or slave in the network. After the role of the Bluetooth equipped device is designated as a slave, and when the slave does not communicate with other Bluetooth equipped devices, the mode is changed to a park mode. In the park mode, the slave receives information from the new network master to update its old network information. In contrast, if the Bluetooth equipped device, a new slave NS, whose role is changed as a slave attempts to communicate with another slave within the network, the new slave NS requests the network master to cut off the connection with the corresponding slave CS, communicates with the corresponding slave CS, and then cuts off the connection with the corresponding slave CS in order to return into the network.

[0006] As described previously, the Bluetooth equipped device can serve as the master or a slave in the network depending on the response to the inquiry. The network consisting of Bluetooth equipped devices allows entering of new Bluetooth equipped devices into the network, sharing information with other Bluetooth equipped devices in the network, and communication among any Bluetooth equipped device of the network in response to a request of any of the Bluetooth equipped devices.

[0007] However, there is a need for designating a new master or reconfiguring the network when the network master cannot serve as a master at a point of time, for example, when power is exhausted or the master leaves the network operating region.

[0008] WO 01/03379 (Siemens) published on 11 January 2001 and having a priority of 1 July 1999 falls under Article 54(3) EPC. The document describes a wireless data transmission network and method for the management of the same in which a data transmission network comprises a number of nodes which are set up to function optionally as a master or a slave. The master is in a position to command a slave which guarantees the best transmission quality to the remaining slave, to take over the master function.

[0009] "BLUETOOTH Specification Version 1.0B, Core, Base Band Specification, Channel Control", Specification of the BLUETOOTH System, Volume 1, 1

December 1999 (1999-12-01), page 95 to 126, XP002174708 describes aspects of the BLUETOOTH specification and provides background information as to how master-slave relationships are defined in BLUETOOTH.

[0010] With a view to solve or reduce the above problems, it is a first aim of embodiments of the present invention to provide a method for building up rank information on a backup master for use in selecting a new master of a network, when a pre-existing network master no longer remains as a master in the network at a point of time.

[0011] A second aim is to provide a method for designating a new master of the network according to the backup master rank information, when a pre-existing network master no longer remains in its role in the network at a point of time.

[0012] A third aim is to provide a method for establishing connections between the new master of the network and the remaining slaves, when a pre-existing network master no longer remains in its role in the network at a point of time.

[0013] According to a first aspect of the invention, there is provided a method for building up backup master information, comprising the steps of: (a) at a network master receiving connection information from at least one of a plurality of slaves in a network; (b) at the network master determining a priority of said at least one of the plurality of slaves to be used as a backup master, when the network master disappears, according to the received connection information; and (c) characterised in that the determined priority information of backup master is announced to at least another one of the plurality of slaves through a broadcasting channel.

[0014] Preferably, the steps (a) through (c) are repeated in a predetermined cycle.

[0015] Preferably, the received connection information includes received signal strength indication (RSSI) and/or link quality information.

[0016] Preferably, in the step (b), if said at least one of the plurality of slaves has a higher RSSI than another one of the plurality of slaves, said at least one of the plurality of slaves is given a higher priority, which is used to choose a new network master.

[0017] Preferably, in the step (b), if said at least one of the plurality of slaves has a higher link quality value than another one of the plurality of slaves, said at least one of the plurality of slaves is given a higher priority, which is used to choose a new network master.

[0018] Preferably, the network is a Personal Ad-hoc Network.

[0019] Preferably, at least one of the plurality of slaves perform the following steps following an apparent disappearance of a pre-existing network master of: (1) determining whether the pre-existing network master has disappeared; (2) if the pre-existing network master has disappeared, determining a rank, which is used for choosing a new network master and is received before the disappearance of the pre-existing network master; and (3) changing to a role as the new network master if the rank is highest of any one of a plurality of slaves.

[0020] Preferably, after the step (3), further comprising the step (4) of performing inquiry scan and page scan.

[0021] Preferably, after step (4), the method comprises the steps of: (5) determining whether a new device attempts to establish a connection through the network; (6) accepting a request of the new device for connection, requesting the new device to change to a role as a slave, and remaining as the new network master; (7) storing information of the new device, and announcing the information of the new network master and each of the plurality of slaves linked throughout the network, to each of the plurality of slaves linked throughout the network; and (8) checking for a change of a master mode if there is no connection request from the new device in step (5), returning to the step (4) when no change to the master mode is determined, and terminating the master mode when a change to the master mode is determined.

[0022] Preferably, in the step (8), the change of the master mode is determined when a role of a device serving as the pre-existing network master is changed to a role as one of the plurality of slaves, by a user, when a Bluetooth function of the pre-existing network master is switched off, or when power of the pre-existing network master is turned off.

[0023] Preferably, step (1) comprises the sub-steps of: (1a) checking a connection status with the pre-existing network master; (1b) attempting to reconnect with the pre-existing network master if disconnection is detected in sub-step (a1); (1c) checking whether reconnection with the pre-existing network master is successful, and returning to the sub-step (1a) if the reconnection with the pre-existing network master is successful; and (ld) determining whether the pre-existing network master has disappeared, if reconnection with the pre-existing network master is not established in sub-step (1c), and informing a host of the event as a "Disconnection Complete Event".

[0024] Preferably, the sub-step (1a) is repeated in a predetermined cycle while the connection with the pre-existing network master remains.

[0025] Preferably, at least one of the plurality of slaves performs the following steps following an apparent disappearance of a pre-existing network master of (A) checking whether the pre-existing network master has disappeared; (B) checking backup master rank information, when it is determined that the pre-existing network master has disappeared in the step (A); (C) attempting to establish a connection with the new network master when it is determined that one of the remaining plurality of slaves does not have the highest priority, according to the backup master rank information; and (D) remaining as one of the remaining plurality of slaves if a connection with the new network master is established in the step (C).

[0026] For a better understanding of the invention, and to show how embodiments of the same may be carried into effect, reference will now be made, by way of example, to the accompanying diagrammatic drawings in which:

Figure 1 is block diagram of a Bluetooth system capable of constructing a network;

Figure 2 is a flowchart illustrating a conventional method for designating a Bluetooth equipped device as the master or slave of a network;

Figure 3 illustrates the configuration of a network in which Bluetooth equipped devices are linked together;

Figure 4 is a flowchart illustrating a method for building up information on backup masters in a network, according to the present invention;

Figure 5 illustrates the backup master rank information of each slave used to choose a new network master, which is determined by the method of Figure 4;

Figure 6 is a flowchart illustrating a method for designating a new master, according to the backup master rank information, in order to reconstruct the network when the pre-existing network master leaves the network operating region;

Figure 7 is a flowchart illustrating in detail the step of detecting when the pre-existing network master of Figure 6 leaves;

Figure 8 is a flowchart illustrating a method for establishing connections between a new master and remaining slaves when a pre-existing network master disappears;

Figure 9 illustrates the configuration of a Network reconstructed after the pre-existing network master disappears;

Figure 10 illustrates the configuration of another network through which Bluetooth equipped devices are connected together; and

Figure 11 illustrates the configuration of a network reconfigured after the network master of Figure 10 disappears.

[0027] A method for designating a new master of a network when a pre-existing network master disappears, according to embodiments of the present invention, contributes to increasing a probability of holding connection throughout the network. Preferred embodiments of the present invention will be described with reference to the appended drawings. In the drawings, like reference numerals are used to refer to like elements throughout.

[0028] Figure 1 is a block diagram of a Bluetooth system capable of configuring a network. In Figure 1, a Bluetooth module 200 is a separate unit connected to a Bluetooth equipped device (hereinafter, referred to as Bluetooth host 100) through a cable, compliant with the wired serial communications standard. An HCI (Host Controller Interface) transport layer 120, which is RS232C or USB (Universal Serial Bus), controls the Bluetooth module 200 according to a series of commands prescribed in the standard and their responses, and performs data transmission and reception between the Bluetooth host 100 and the Bluetooth module 200.

[0029] A L2CAP (Logical Link Control and Adaptation Protocol) 140, which is a standard communications protocol, multiplexes a variety of protocols in upper layers. A HCI driver 130 allows transmission of HCI standard commands and receives the responses thereto, and transmits and receives data through the L2CAP 140. A Bluetooth service user 150 is a Bluetooth service application. A network manager 160 serves to manage the network by integrating devices equipped with the Bluetooth module 200 into the single network. The network manager 160 interfaces with a user application program. The level of the network manager 160 is equal to the upper level of the L2CAP 140. Thus the network manager 160 manages the network using the L2CAP 140, through communications with the network manager of a network master.

[0030] A link manager 230, which is located in the Bluetooth module 200, performs the commands transmitted from the Bluetooth host 100 through the HCI transport layer 120 and notifies the Bluetooth host 100 of the result. The link manager 230 manages the overall operation of the Bluetooth module 200 by controlling a link baseband controller 220 and a Bluetooth radio 210. Here, the link manager 230 uses link manager protocol (LMP) 240 for communications with the link manager of another Bluetooth equipped device. The link baseband controller 220 operates according to the command of the link manager 230. The Bluetooth radio 210 wirelessly transmits information according to standard specifications.

[0031] Figure 2 is a block diagram of a Bluetooth system capable of constructing a network.

[0032] Figure 3 illustrates the configuration of a network in which Bluetooth equipped devices are linked together.

[0033] It is assumed that Bluetooth equipped devices are designated as a master or slaves by the method of Figure 2, and distributed as shown in Figure 3. In general, whether wireless communication is successful or not is determined by the power of transmitted waves or the sensitivity of received waves. In the present embodiment, the network consists of a network master 400 and

network slaves 300, i.e., A 300a, B 300b, C 300c, D 300d and E 300e. As shown in Figure 3, the network slaves 300 are located around the network master 400, within the radio coverage. In the Bluetooth wireless communication field, a standard radio coverage is defined as 10 m. Thus, a maximum allowable distance between the network master 400 and a network slave 300 is 10 m. In Figure 3, the circle 250, enclosed by dashed lines, is a region with a radius d corresponding to the maximum radio coverage from the network master 400. Bluetooth equipped devices located in the circle 250 can be configured as a network with a network master 400.

[0034] Figure 4 illustrates a method for building up information on backup masters in a network, according to the present invention. Referring to Figures 3 and 4, the network master 400 receives connection information from the network slaves 300, i.e., A 300a, B 300b, C 300c, D 300d and E 300e, in order to check the connection status with each of the network slaves 300 in the network (S310). The connection information includes received signal strength indication (RSSI) and/or link quality. The RSSI, which is measured by each slave and provided to the network master 400, is closely related to the distances between each of the network slaves 300 and the network master 400. The link quality information is an index of error rate in data transmission between the network master 400 and each slave, and is associated with the distance between the master 400 and each of the network slaves 300, and the presence or absence of obstructions therebetween. Network slaves 300 can read the RSSI value of a signal transmitted from the network master 400 using an HCI command, "Read-RSSI", prescribed in the Bluetooth standard. Network slaves 300 also get 1-byte numeric link information using a standard HCI command, "Get_Link_Quality". The higher the RSSI and link quality values, the better the connection status. The network master 400 determines the rank information of a backup master to be chosen as a new network master 400 when the pre-existing network master leaves the network operating region, based on the connection information (S330). In the present embodiment, the rank information on the backup masters more likely to be chosen as a new network master is determined according to RSSI and/or link quality values. That is, a slave having higher RSSI and/or link quality values is given a higher rank as a backup master in order to be chosen as a new network master. This increases the probability of reconfiguring a network with the remaining slaves when a pre-existing network master leaves the network operating region. After the rank of the backup master, which is used for choosing a new network master, is determined with respect to all the slaves in step S330, the network master 400 announces the rank information of the backup master determined in step S330, to each slave through a broadcasting channel (S350).

[0035] The network master 400 determines the new backup master rank information, which is used for choosing a new network master with respect to the slaves, every predetermined cycle, and announces the result to all of the network slaves 300. This is done in consideration of RSSI variations due to a change in location of the network master 400 and/or network slaves 300, and link quality variations due to, for example, the presence or absence of obstructions between the network master 400 and network slaves 300, or a change in other conditions.

[0036] Figure 5 illustrates the backup master rank information used for choosing a new network master with respect to the slaves in the network, which is determined by the method illustrated with reference to Figure 4. As shown in FIG 5, slave A 300a is designated as the fourth ranked backup master BACKUP 4, slave B 300b is designated as the first ranked backup master BACKUP 1, slave C 300c is designated as the second ranked backup master BACKUP 2, slave D 300d is designated as the third ranked backup master BACKUP 3, and slave E 300e is designated as the fifth ranked backup master BACKUP 5. When power of the pre-existing network master 400 is exhausted or the pre-existing network master 400 leaves the network operating region, a network is reconfigured with the remaining network slaves 300 by designating a new master according to the rank information of the backup master more likely to be chosen as a new network master.

[0037] A method for reconfiguring a network when a pre-existing network master leaves the network operating region will now be described with reference to Figures 6 through 9. After the rank information of the backup master more likely to be chosen as a new network master is determined as illustrated in Figure 5, each of the network slaves 300 A, B, C, D and E determines whether the pre-existing network master 400 leaves the Network operating region (S410). Step S410 involves the sub-steps illustrated in Figure 7. The determination as to whether the pre-existing network master 400 leaves the network operating region 250 is achieved by detecting a disconnection between the pre-existing network master 400 and each of the slaves. According to the Bluetooth standard version 1.0, Bluetooth equipped devices monitor the mutual connection status every cycle, for example, in a period of 0.625 ms-40.9 sec, with a link supervision timer. Based on this, the network slaves 300 check their connection status with the network master 400 (S402). The cycle of monitoring the connection status with the network master can be determined according to the values of the link supervision timer. The network slaves 300 periodically check the connection status with the network master 400 using the link supervision timer. In step S402, if connections between the network master 400 and network slaves 300 are maintained, the network slaves 300 continue to monitor the connection status with the network master 400 every predetermined cycle. However, if a disconnection between the network master 400 and network slaves 300 is detected in step S402, a corresponding

slave attempts to establish reconnection (S404). Next, the corresponding slave checks for whether reconnection with the network master 400 is established (S406). If yes, the process returns to step S402. In contrast, if reconnection between the network master 400 and the corresponding slave is not established, the corresponding slave determines the event as that the network master 400 left the network operating region, and informs the Bluetooth host of "Disconnection_Complete Event" (S408).

[0038] Referring back to Figure 6, when the absence of the network master 400 in the network operating region is identified, each of the slaves checks for backup master rank information, which is used to choose a new network master (S412). In step S412, each of the network slaves 300 checks for whether its rank is given the highest priority in order to be chosen as a new network master. If so, the corresponding slave changes its role to a new master (S415). The new master performs inquiry scan (S420) and page scan (S430). Next, the new master checks whether any Bluetooth equipped device attempts to establish a connection thereto (S440). If yes, the network master accepts the request for connection of a Bluetooth equipped device. The new master requests the Bluetooth equipped device to set its role to a slave, and the new master remains in its role as the network master (S450). Then, the new master stores information on the newly entering slave and announces information on the other slaves as well as its own information, to the new slave. In addition, the new master also stores information on other new slaves that enter the network operating region or the slaves that leave the network operating region, such as the addresses or names of the slaves, etc., and announces the stored information to the other slaves (S460).

[0039] Meanwhile, in step S440, if there is no connection request from any Bluetooth equipped device, a determination of whether to change the mode is made (S470). The mode can be changed when a user intends to change the role of the Bluetooth equipped device from the master to a slave, when the Bluetooth function is switched off, or when power is turned off. In step S470, if there is no request for mode change, the process returns to step S420 to continue its role as the network master. In contrast, if a determination is made in step 470 to change the mode, the master mode is ended. When a pre-existing network master leaves the network operating region, a new master of the network is chosen and performs its role, as described above.

[0040] Meanwhile, in step S412, if the rank information of the backup master of the slave is not the highest priority, the process A as shown in Figure 8 is as follows. The slave initializes a parameter t indicating the rank of the backup master (S515), and a parameter N indicating the number of connections attempted (S520). After the connection attempt parameter N is initialized, the slave attempts to establish a connection with the slave designated as the *t*-th ranked backup master (hereinafter *t*-th ranked slave)(S525), and checks for whether the connection with the *t*-th ranked slave is established (S530). In step S530, if the connection is successful, then the slave designated as the *t*-th ranked slave in a new network, remains as a slave (S560) and receives new network information from the new master (S565). When each of the Bluetooth equipped devices that maintain their roles as a slave in the new network do not communicate with other slaves, they change their current mode to a park mode, and update their own network information with the new version of information provided by the new network master. Meanwhile, if any of the Bluetooth equipped devices serving as a slave desire to communicate with another slave in the Network, the Bluetooth equipped devices can request the new network master to end the connection with the slave to which the Bluetooth equipped devices attempts to connect, communicate with the slave, and then end the connection with the slave in order to return into the network.

[0041] Meanwhile, in step S530, if the connection between the corresponding slave and the *t*-th ranked slave is not established, then the corresponding slave increments the connection attempt parameter N (S535) and checks whether a predetermined number of connections have been attempted (S540). In step S540, if the connection attempt parameter N is smaller than the predetermined number of connections attempted, the corresponding slave continues to attempt connection with the *t*-th ranked slave (S525). Otherwise, if the predetermined number of connections have been attempted in step S540, the corresponding slave increments the backup master rank parameter *t* (S545), and compares the increased backup master rank parameter *t* with its rank, used for choosing a new master (S550). In step S550, if the increased backup master rank parameter t is not the same as the rank of the corresponding slave, the process returns to step S520. Otherwise, the slave changes its role to a new network master 400 (S555).

[0042] As shown in Figure 5, before the network master 400 leaves the network operating region, all of the first through fifth backup master ranked network slaves 300 are distributed within the radio coverage distance d of the network 250. Figure 9 shows a network reconfigured around the first ranked slave 300b BACKUP 1 after the network master 400 disappears. As shown in Figure 9, the distance *d* between the fifth ranked slave 300e BACKUP 5 and the first ranked slave 300b BACKUP 1 is greater than the radio coverage distance *d*. In other words, as for the network 270, reconfigured after the network master 400 disappears, the fifth ranked slave 300e BACKUP 5 is located outside of the network 270. Accordingly, although the fifth ranked slave 300b BACKUP 5 attempts to establish connection with the first ranked slave 300b BACKUP 1 after the leaving of the pre-existing network master 400 is recognized, the connection is unsuccessful and thus it cannot be a node of the new network 270. Accordingly, the fifth ranked slave 300e BACKUP 5 attempts connection with another

Bluetooth equipped devices, or serves as a master in order to construct a new network. Figure 10 illustrates the configuration of another network 280 with Bluetooth equipped devices and Figure 11 illustrates the configuration of networks reconfigured after the network master 410 of Figure 10 leaves the network operating region. Referring to Figure 10, the network 280 consists of network master 410 and network slaves 310. The network slaves 310 have first to fifth backup master rank information. In Figure 11, reference numeral 500 represents a first network where the first ranked slave 310a BACKUP 1 of Figure 10 serves as a new master. Reference numeral 600 represents a second network reconfigured with the slaves located outside of the radio coverage distance d of the first Network 500. For the second network 600, among the slaves located outside of first network 500, the third ranked slave 310c BACKUP 3, which has a relatively higher priority, which is used to choose a new master, changed its role to a new master in order to construct the second network 600.

[0043] When the reconfiguration of a network is completed as mentioned above, optimization of transmission power between the new network master and the slaves is required. As previously mentioned, the method of building up priority information about a backup master for use in selecting a new master of a network when a pre-existing network master disappears, the method for designating a new master according to the backup master rank information, and the method for establishing connections between a new master and remaining slaves, when a pre-existing network master leaves the network operating region, increases a probability of holding connection throughout the network.

[0044] While this invention has been particularly shown and described with reference to preferred embodiments thereof, it will be understood by those skilled in the art that various changes in form and details may be made thereto without departing from the scope of the invention as defined by the appended claims.

Claims

1. A method for building up backup master information, comprising the steps of:

   (a) at a network master receiving connection information from at least one of a plurality of slaves (300) in a network;

   (b) at the network master determining a priority of said at least one of the plurality of slaves to be used as a backup master, when the network master (400) disappears, according to the received connection information; and

   (c) announcing the determined priority information of backup master (300b) to at least another one of the plurality of slaves through a broadcasting channel.

2. The method of claim 1 or 2, wherein the steps (a) through (c) are repeated in a predetermined cycle.

3. The method of claim 1, wherein the received connection information includes received signal strength indication (RSSI) and/or link quality information.

4. The method of claim 3, wherein, in the step (b), if said at least one of the plurality of slaves has a higher RSSI than another one of the plurality of slaves, said at least one of the plurality of slaves is given a higher priority, which is used to choose a new network master.

5. The method of claim 3, wherein, in the step (b), if said at least one of the plurality of slaves has a higher link quality value than another one of the plurality of slaves, said at least one of the plurality of slaves is given a higher priority, which is used to choose a new network master.

6. The method of any preceding claim, wherein the network is a Personal Ad-hoc Network.

7. The method according to claim 1, wherein at least one of the plurality of slaves perform the following steps following an apparent disappearance of a pre-existing network master of:

   (1) determining whether the pre-existing network master (400) has disappeared;

   (2) if the pre-existing network master (400) has disappeared, determining a rank, which is used for choosing a new network master and is received before the disappearance of the pre-existing network master (400); and

   (3) changing to a role as the new network master if the rank is highest of any one of a plurality of slaves.

8. The method of claim 7, wherein after the step (3), further comprising the step (4) of performing inquiry scan and page scan.

9. The method of claim 8, after step (4), further comprising the steps of:

   (5) determining whether a new device attempts to establish a connection through the network;

   (6) accepting a request of the new device for connection, requesting the new device to

change to a role as a slave, and remaining as the new network master;

(7) storing information of the new device, and announcing the information of the new network master and each of the plurality of slaves linked throughout the network, to each of the plurality of slaves linked throughout the network; and

(8) checking for a change of a master mode if there is no connection request from the new device in step (5), returning to the step (4) when no change to the master mode is determined, and terminating the master mode when a change to the master mode is determined.

10. The method of claim 9, wherein, in the step (8), the change of the master mode is determined when a role of a device serving as the pre-existing network master is changed to a role as one of the plurality of slaves, by a user, when a Bluetooth function of the pre-existing network master is switched off, or when power of the pre-existing network master is turned off.

11. The method of any of claims 7 to 10, wherein step (1) comprises the sub-steps of:

(1a) checking a connection status with the pre-existing network master;

(1b) attempting to reconnect with the pre-existing network master if disconnection is detected in sub-step (a1);

(1c) checking whether reconnection with the pre-existing network master is successful, and returning to the sub-step (1a) if the reconnection with the pre-existing network master is successful; and

(1d) determining whether the pre-existing network master has disappeared, if reconnection with the pre-existing network master is not established in sub-step (1c), and informing a host of the event as a "Disconnection Complete Event".

12. The method of claim 11, wherein the sub-step (1a) is repeated in a predetermined cycle while the connection with the pre-existing network master remains.

13. The method according to claim 1, wherein at least one of the plurality of slaves performs the following steps following an apparent disappearance of a pre-existing network master of:

(A) checking whether the pre-existing network master has disappeared;

(B) checking backup master rank information, when it is determined that the pre-existing network master has disappeared in the step (A);

(C) attempting to establish a connection with the new network master when it is determined that one of the remaining plurality of slaves does not have the highest priority, according to the backup master rank information; and

(D) remaining as one of the remaining plurality of slaves if a connection with the new network master is established in the step (C).

Patentansprüche

1. Verfahren zum Aufbau von Datensicherungsmasterinformation, die Schritte umfassend:

(a) bei einem Netzmaster Empfangen von Verbindungsinformation von mindestens einem von einer Vielzahl von Slaves (300) in einem Netz;

(b) bei dem Netzmaster Bestimmen einer Priorität von dem mindestens einen aus der Vielzahl von Slaves, der als ein Datensicherungsmaster zu verwenden ist, wenn der Netzmaster (400) verschwindet, gemäß der empfangenen Verbindungsinformation; und

(c) Bekanntgeben der bestimmten Prioritätsinformation vom Datensicherungsmaster (300b) zu mindestens einem anderen aus der Vielzahl von Slaves durch einen Rundrufkanal.

2. Verfahren nach Anspruch 1 und 2, wobei die Schritte (a) bis (c) in einem vorbestimmten Zyklus wiederholt werden.

3. Verfahren nach Anspruch 1, wobei die empfangene Verbindungsinformation Empfangssignalstärkenanzeige (received signal strength indication, RSSI) und/oder Verbindungsqualitätsinformation umfasst.

4. Verfahren nach Anspruch 3, wobei in dem Schritt (b), wenn der mindestens eine aus der Vielzahl von Slaves eine höhere RSSI als ein anderer aus der Vielzahl von Slaves hat, dem mindestens einen aus der Vielzahl von Slaves eine höhere Priorität gegeben wird, die verwendet wird, um einen neuen Netzmaster auszuwählen.

5. Verfahren nach Anspruch 3, wobei in dem Schritt (b), wenn der mindestens eine aus der Vielzahl von Slaves einen höheren Verbindungsqualitätswert als ein anderer aus der Vielzahl von Slaves hat, dem mindestens einen aus der Vielzahl von Slaves eine höhere Priorität gegeben wird, die verwendet wird, um einen neuen Netzmaster auszuwählen.

6. Verfahren nach einem beliebigen vorangehenden Anspruch, wobei das Netz ein persönliches Ad-hoc-Netz ist.

7. Verfahren nach Anspruch 1, wobei mindestens einer aus der Vielzahl von Slaves die folgenden Schritte in Folge zu einem offensichtlichen Verschwinden eines vorher existierenden Netzmasters durchführt:

(1) Bestimmen, ob der vorher existierende Netzmaster (400) verschwunden ist;

(2) wenn der vorher existierende Netzmaster (400) verschwunden ist, Bestimmen eines Rangs, der zum Auswählen eines neuen Netzmasters verwendet wird und vor dem Verschwinden von dem vorher existierenden Netzmaster (400) empfangen wird; und

(3) Ändern zu einer Rolle als der neue Netzmaster, wenn der Rang der höchste von einem beliebigen aus einer Vielzahl von Slaves ist.

8. Verfahren nach Anspruch 7, wobei nach dem Schritt (3) ferner der Schritt (4) zum Durchführen einer Rechercheabtastung und einer Seitenabtastung umfasst wird.

9. Verfahren nach Anspruch 8, nach Schritt (4) ferner die Schritte umfassend:

(5) Bestimmen, ob eine neue Vorrichtung versucht, eine Verbindung durch das Netz herzustellen;

(6) Akzeptieren einer Anforderung der neuen Vorrichtung für eine Verbindung, Auffordern der neuen Vorrichtung, zu einer Rolle als ein Slave zu wechseln und Verbleiben als der neue Netzmaster;

(7) Speichern von Information von der neuen Vorrichtung und Bekanntmachen der Information von dem neuen Netzmaster und jedem aus der Vielzahl von Slaves, die überall in dem Netz verknüpft sind, zu jedem aus der Vielzahl von Slaves, die überall in dem Netz verknüpft sind; und

(8) Überprüfen einer Änderung eines Mastermodus, wenn es keine Verbindungsanforderung von der neuen Vorrichtung in Schritt (5) gibt, Zurückkehren zu dem Schritt (4), wenn keine Änderung an dem Mastermodus bestimmt wird und Beenden des Mastermodus, wenn eine Änderung an dem Mastermodus bestimmt wird.

10. Verfahren nach Anspruch 9, wobei in dem Schritt (8) die Änderung des Mastermodus bestimmt wird, wenn eine Rolle von einer Vorrichtung, die als der vorher existierende Netzmaster dient, zu einer Rolle als einer aus der Vielzahl von Slaves durch einen Benutzer geändert wird, wenn eine Bluetooth-Funktion von dem vorher existierenden Netzmaster abgeschaltet wird oder wenn die Energie von dem vorher existierenden Netzmaster abgeschaltet wird.

11. Verfahren nach beliebigen der Ansprüche 7 bis 10, wobei Schritt (1) die Teilschritte umfasst:

(1a) Überprüfen eines Verbindungsstatus mit dem vorher existierenden Netzmaster;

(1b) Versuchen, sich wieder mit dem vorher existierenden Netzmaster zu verbinden, wenn in Teilschritt (a1) eine Trennung erfasst wird;

(1c) Überprüfen, ob eine Wiederverbindung mit dem vorher existierenden Netzmaster erfolgreich ist, und Zurückkehren zu dem Teilschritt (1a), wenn die Wiederverbindung mit dem vorher existierenden Netzmaster erfolgreich ist; und

(1d) Bestimmen, ob der vorher existierende Netzmaster verschwunden ist, wenn eine Wiederverbindung mit dem vorher existierenden Netzmaster in Teilschritt (1c) nicht hergestellt wird, und Informieren eines Hosts über das Ereignis als ein "Trennungsabschlussereignis".

12. Verfahren nach Anspruch 11, wobei der Teilschritt (1a) in einem vorbestimmten Zyklus wiederholt wird, während die Verbindung mit dem vorher existierenden Netzmaster verbleibt.

13. Verfahren nach Anspruch 1, wobei mindestens einer aus der Vielzahl von Slaves die folgenden Schritte in Folge zu einem offensichtlichen Verschwinden eines vorher existierenden Netzmasters durchführt:

(A) Überprüfen, ob der vorher existierende Netzmaster verschwunden ist;

(B) Überprüfen von Datensicherungsmasterranginformation, wenn bestimmt wird, dass der vorher existierende Netzmaster in dem Schritt (A) verschwunden ist;

(C) Versuchen, eine Verbindung mit dem neuen Netzmaster herzustellen, wenn bestimmt wird, dass einer aus der verbleibenden Vielzahl von Slaves gemäß der Datensicherungsmasterranginformation nicht die höchste Priorität hat; und

(D) Verbleiben als einer aus der verbleibenden Vielzahl von Slaves, wenn eine Verbindung mit dem neuen Netzmaster in dem Schritt (C) hergestellt wird.

Revendications

1. Procédé pour élaborer des informations de maître de secours comprenant consistant à :

   (a) au niveau d'un maître de réseau, recevoir des informations de connexion provenant d'au moins l'un d'une pluralité d'esclaves (300) dans un réseau ;
   (b) au niveau du maître de réseau, déterminer une priorité dudit au moins l'un de la pluralité d'esclaves à utiliser en tant que maître de secours, lorsque le maître de réseau (400) disparaît, conformément aux informations de connexion reçues ; et
   (c) annoncer les informations de priorité déterminées de maître de secours (300b) à au moins un autre de la pluralité d'esclaves par l'intermédiaire d'un canal de diffusion.

2. Procédé selon la revendication 1, dans lequel les étapes (a) à (c) sont répétées dans un cycle prédéterminé.

3. Procédé selon la revendication 1, dans lequel les informations de connexion reçues comprennent une indication d'intensité de signal reçu (RSSI) et/ou des informations de qualité de liaison.

4. Procédé selon la revendication 3, dans lequel, à l'étape (b), si ledit au moins l'un de la pluralité d'esclaves a une RSSI supérieure à celle d'un autre de la pluralité d'esclaves, ledit au moins l'un de la pluralité d'esclaves reçoit une priorité plus élevée, laquelle est utilisée pour choisir un nouveau maître de réseau.

5. Procédé selon la revendication 3, dans lequel, à l'étape (b), si ledit au moins l'un de la pluralité d'esclaves a une valeur de qualité de liaison supérieure à celle d'un autre de la pluralité d'esclaves, ledit au moins l'un de la pluralité d'esclaves reçoit une priorité plus élevée, laquelle est utilisée pour choisir un nouveau maître de réseau.

6. Procédé selon l'une quelconque des revendications précédentes, dans lequel le réseau est un réseau ad-hoc personnel.

7. Procédé selon la revendication 1, dans lequel au moins l'un de la pluralité d'esclaves effectue les étapes suivantes à la suite d'une disparition apparente d'un maître de réseau préexistant, consistant à :

   (1) déterminer si le maître de réseau préexistant (400) a disparu ;
   (2) si le maître de réseau préexistant (400) a disparu, déterminer un rang, qui est utilisé pour choisir un nouveau maître de réseau et qui est reçu avant la disparition du maître de réseau préexistant (400) ; et
   (3) changer pour un rôle de nouveau maître de réseau si le rang est le plus élevé de l'un quelconque d'une pluralité d'esclaves.

8. Procédé selon la revendication 7, comprenant, après l'étape (3), l'étape (4) consistant à effectuer un balayage d'interrogations et un balayage de page.

9. Procédé selon la revendication 8, comprenant de plus après l'étape (4), les étapes consistant à :

   (5) déterminer si un nouveau dispositif tente d'établir une connexion à travers le réseau ;
   (6) accepter une requête du nouveau dispositif pour une connexion, demander au nouveau dispositif de passer à un rôle d'esclave, et rester en tant que nouveau maître de réseau ;
   (7) mémoriser les informations du nouveau dispositif, et annoncer les informations du nouveau maître de réseau et de chacun de la pluralité d'esclaves liés à travers le réseau à chacun de la pluralité d'esclaves liés à travers le réseau ; et
   (8) vérifier pour un changement de mode de maître s'il n'existe aucune requête de connexion provenant du nouveau dispositif à l'étape (5), retourner à l'étape (4) lorsque aucun changement du mode de maître n'est déterminé, et terminer le mode de maître lorsqu'un changement du mode de maître est déterminé.

10. Procédé selon la revendication 9, dans lequel, à l'étape (8), le changement du mode de maître est déterminé lorsqu'un rôle d'un dispositif servant en tant que maître de réseau préexistant est changé en un rôle d'un de la pluralité d'esclaves, par un utilisateur, lorsqu'une fonction Bluetooth du maître de

réseau préexistant est désactivée, ou lorsque la puissance du maître de réseau préexistant est arrêtée.

11. Procédé selon l'une quelconque des revendications 7 à 10, dans lequel l'étape (1) comprend les sous-étapes consistant à :

(1a) vérifier un état de connexion avec le maître de réseau préexistant ;
(1b) tenter une reconnexion avec le maître de réseau préexistant si une déconnexion est détectée à la sous-étape (1a) ;
(1c) vérifier si une reconnexion avec le maître de réseau préexistant est réussie, et retourner à la sous-étape (1a) si la reconnexion avec le maître de réseau préexistant est réussie ; et
(1d) déterminer si le maître de réseau préexistant a disparu, si une reconnexion avec le maître de réseau préexistant n'est pas établie à la sous-étape (1c), et informer un hôte de l'événement en tant que « événement déconnexion effectuée ».

12. Procédé selon la revendication 11, dans lequel la sous-étape (1a) est répétée dans un cycle prédéterminé tandis que la connexion avec le maître de réseau préexistant subsiste.

13. Procédé selon la revendication 1, dans lequel au moins l'un de la pluralité d'esclaves effectue les étapes suivantes à la suite d'une disparition apparente d'un maître de réseau préexistant, consistant à :

(A) vérifier si le maître de réseau préexistant a disparu ;
(B) vérifier les informations de rang du maître de secours, lorsqu'il est déterminé que le maître de réseau préexistant a disparu à l'étape (A) ;
(C) tenter d'établir une connexion avec le nouveau maître de réseau lorsqu'il est déterminé que l'un de la pluralité restante d'esclaves n'a pas la priorité la plus élevée, conformément aux informations de rang de maître de secours ;
(D) rester en tant que l'un de la pluralité restante d'esclaves si une connexion avec le nouveau maître de réseau est établie à l'étape (C).

FIG. 1

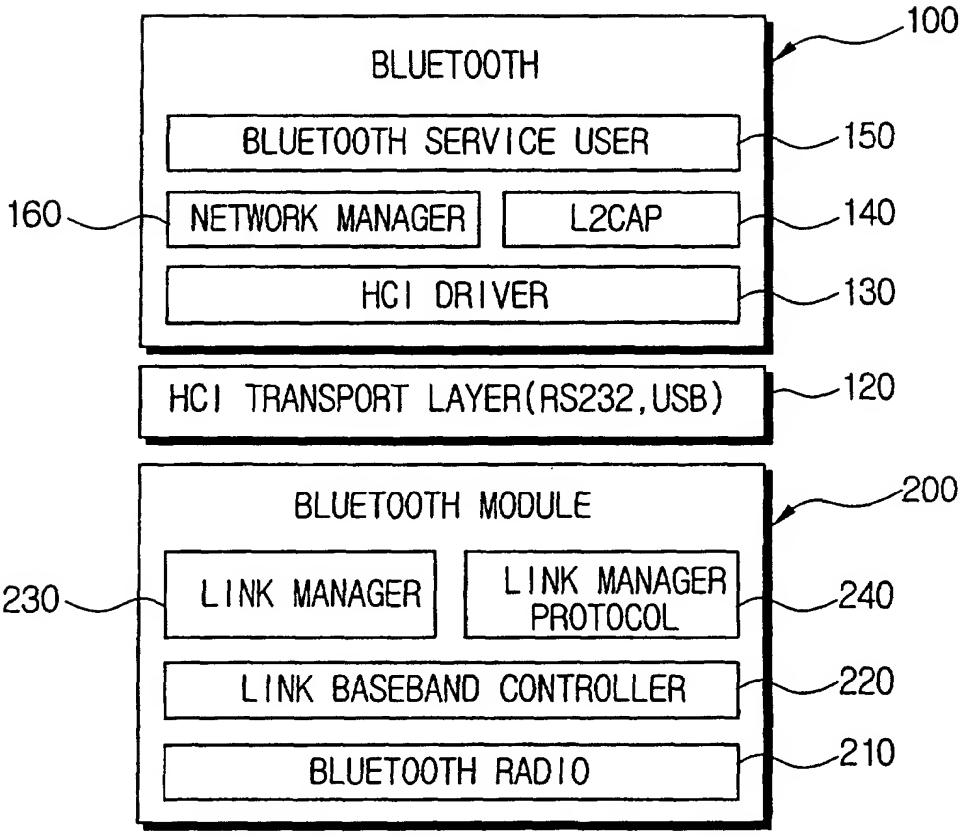

100
BLUETOOTH
BLUETOOTH SERVICE USER
150
160
NETWORK MANAGER
L2CAP
140
HCI DRIVER
130
HCI TRANSPORT LAYER(RS232,USB)
120
200
BLUETOOTH MODULE
230
LINK MANAGER
LINK MANAGER PROTOCOL
240
LINK BASEBAND CONTROLLER
220
BLUETOOTH RADIO
210

FIG.2

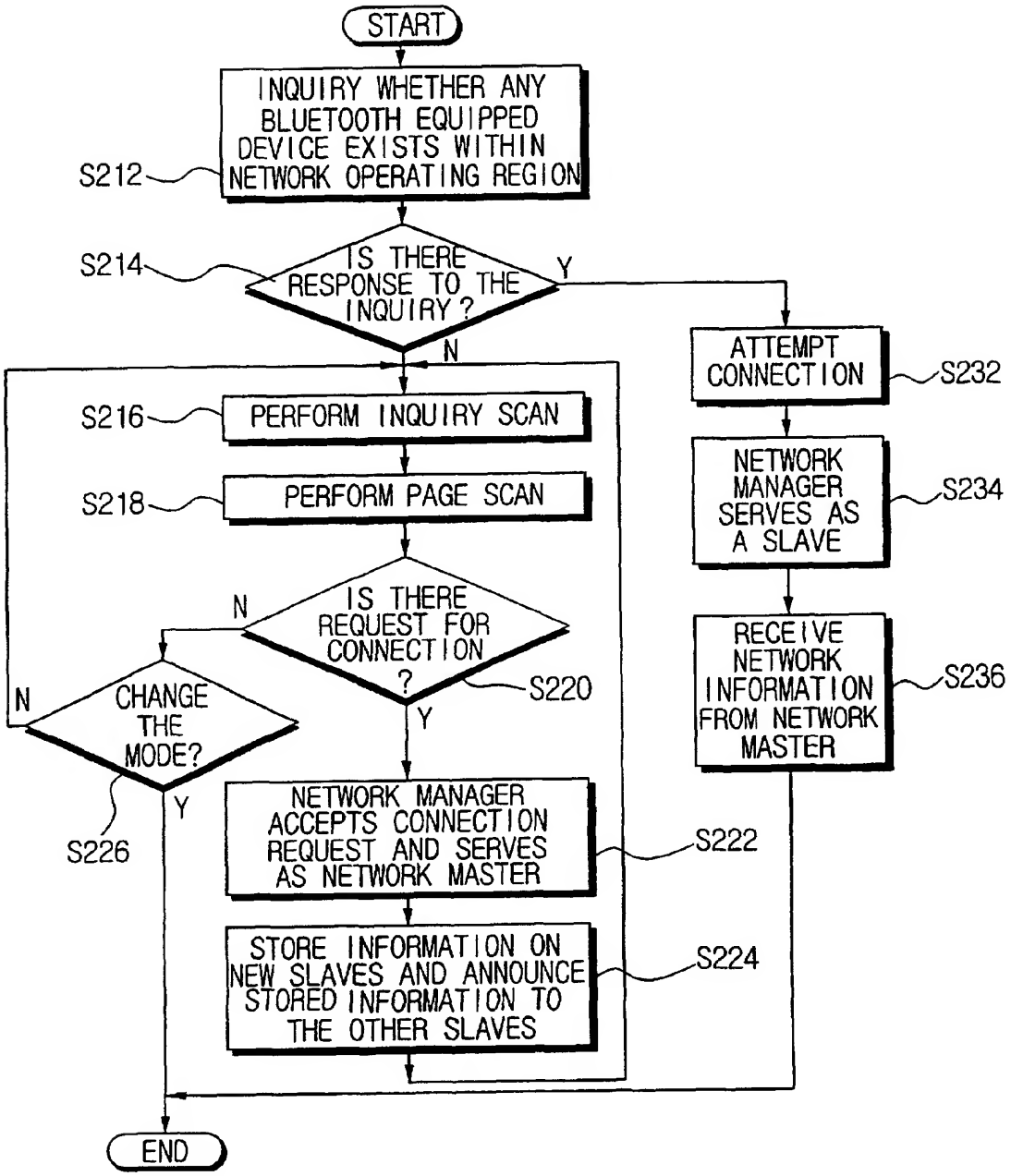

START
INQUIRY WHETHER ANY BLUETOOTH EQUIPPED DEVICE EXISTS WITHIN NETWORK OPERATING REGION
S212
IS THERE RESPONSE TO THE INQUIRY?
S214
Y
N
ATTEMPT CONNECTION
S232
NETWORK MANAGER SERVES AS A SLAVE
S234
RECEIVE NETWORK INFORMATION FROM NETWORK MASTER
S236
S216
PERFORM INQUIRY SCAN
S218
PERFORM PAGE SCAN
IS THERE REQUEST FOR CONNECTION ?
S220
N
Y
CHANGE THE MODE?
N
Y
S226
NETWORK MANAGER ACCEPTS CONNECTION REQUEST AND SERVES AS NETWORK MASTER
S222
STORE INFORMATION ON NEW SLAVES AND ANNOUNCE STORED INFORMATION TO THE OTHER SLAVES
S224
END

FIG.3

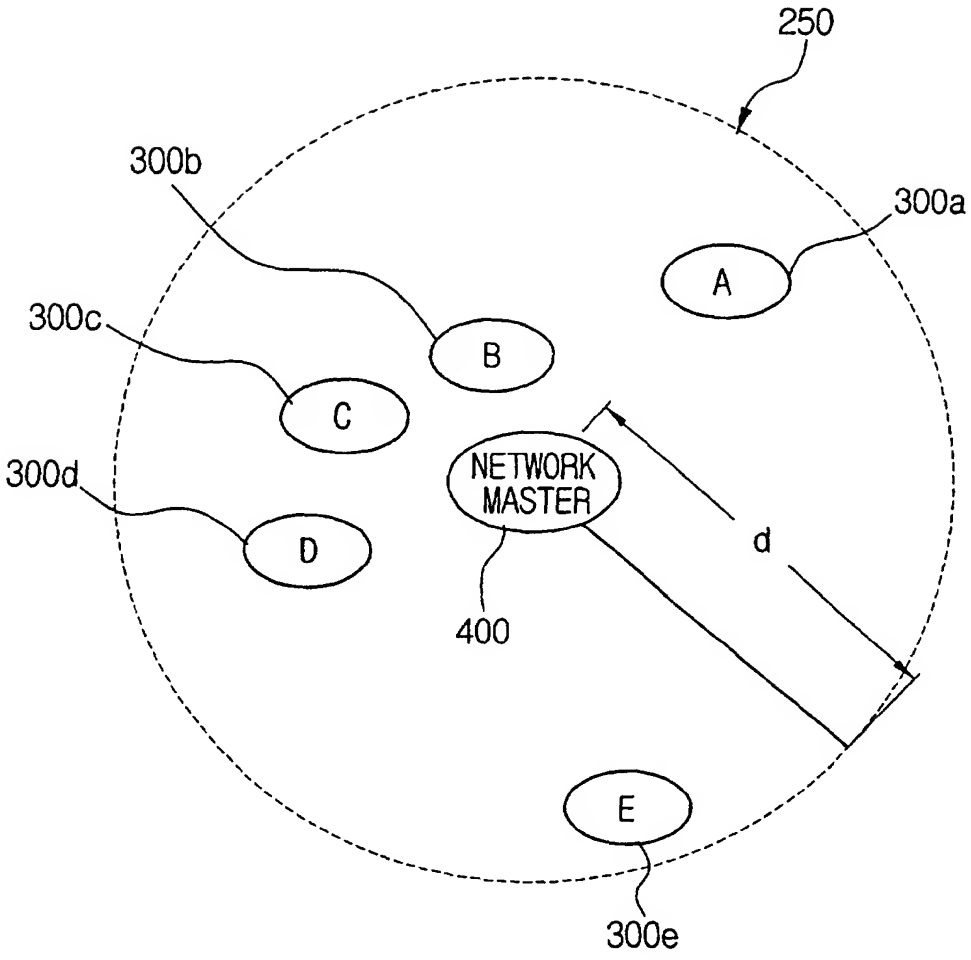


FIG.4

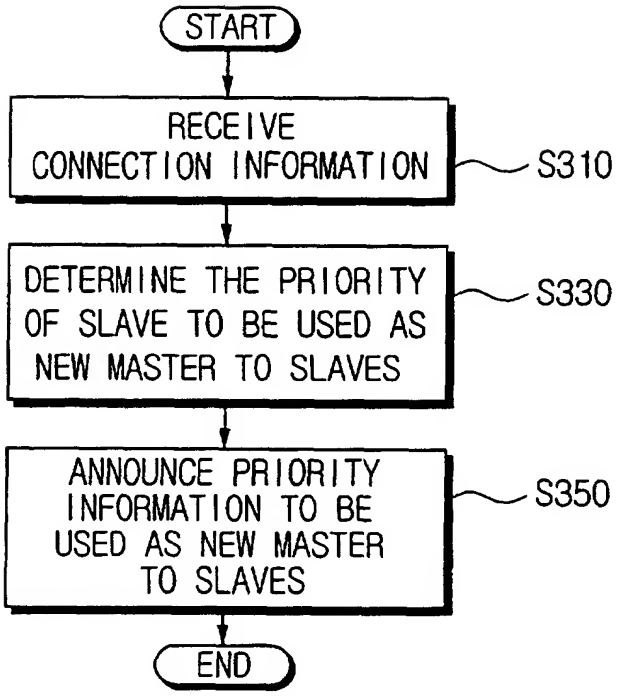

START
RECEIVE CONNECTION INFORMATION
S310
DETERMINE THE PRIORITY OF SLAVE TO BE USED AS NEW MASTER TO SLAVES
S330
ANNOUNCE PRIORITY INFORMATION TO BE USED AS NEW MASTER TO SLAVES
S350
END

FIG.5

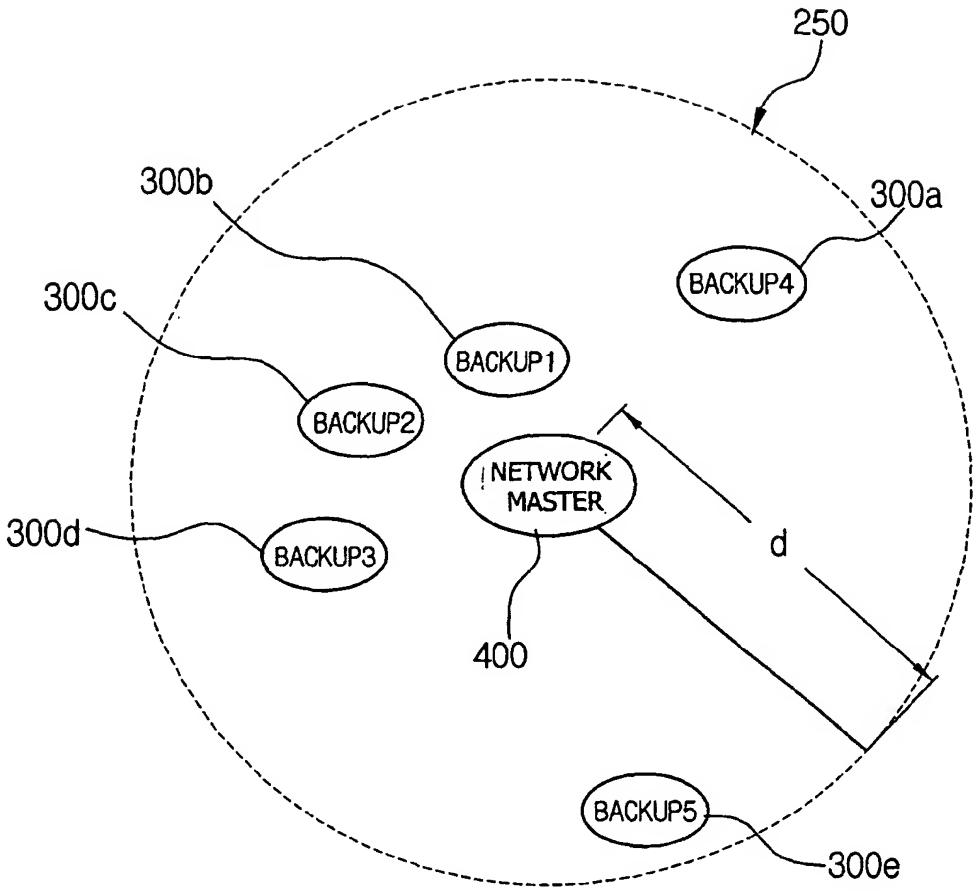

250
300b
300a
300c
BACKUP4
BACKUP1
BACKUP2
NETWORK MASTER
d
300d
BACKUP3
400
BACKUP5
300e

FIG.6

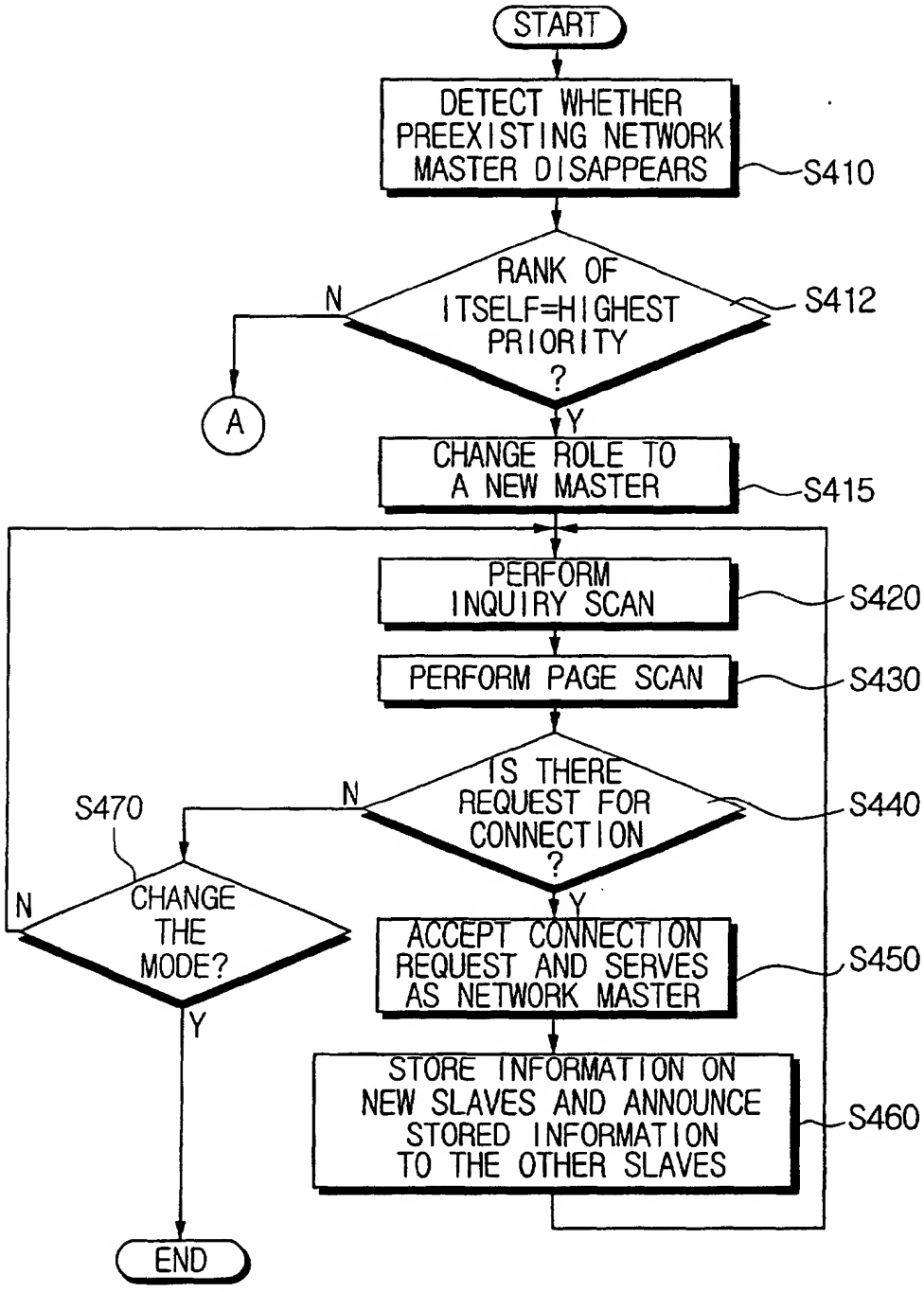

START
DETECT WHETHER PREEXISTING NETWORK MASTER DISAPPEARS
S410
RANK OF ITSELF=HIGHEST PRIORITY ?
S412
N
Y
A
CHANGE ROLE TO A NEW MASTER
S415
PERFORM INQUIRY SCAN
S420
PERFORM PAGE SCAN
S430
IS THERE REQUEST FOR CONNECTION ?
S440
N
Y
S470
CHANGE THE MODE?
N
Y
ACCEPT CONNECTION REQUEST AND SERVES AS NETWORK MASTER
S450
STORE INFORMATION ON NEW SLAVES AND ANNOUNCE STORED INFORMATION TO THE OTHER SLAVES
S460
END

FIG.7

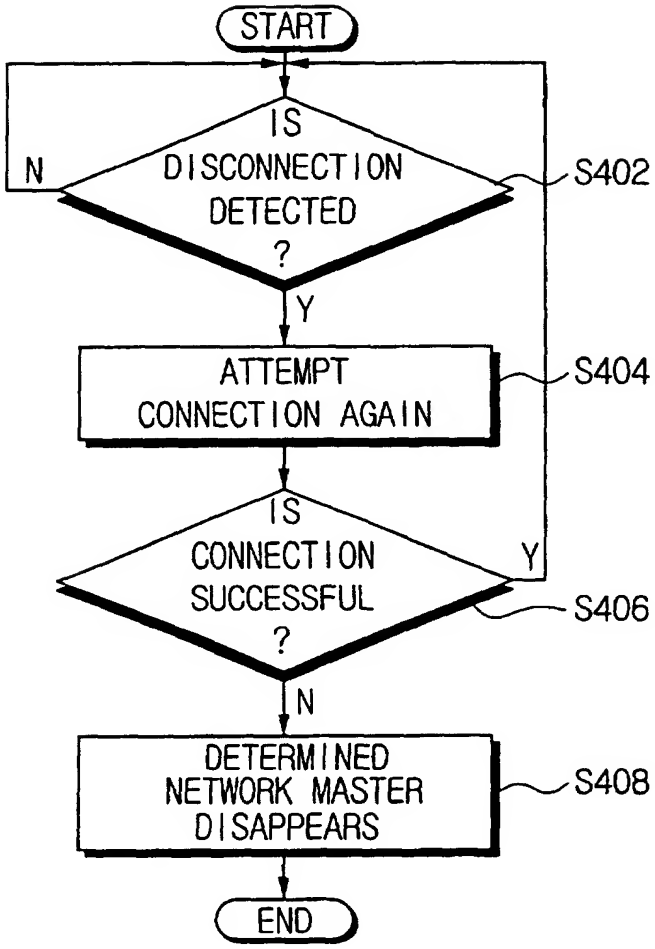

START
IS DISCONNECTION DETECTED ?
N
Y
S402
ATTEMPT CONNECTION AGAIN
S404
IS CONNECTION SUCCESSFUL ?
Y
N
S406
DETERMINED NETWORK MASTER DISAPPEARS
S408
END

FIG.8

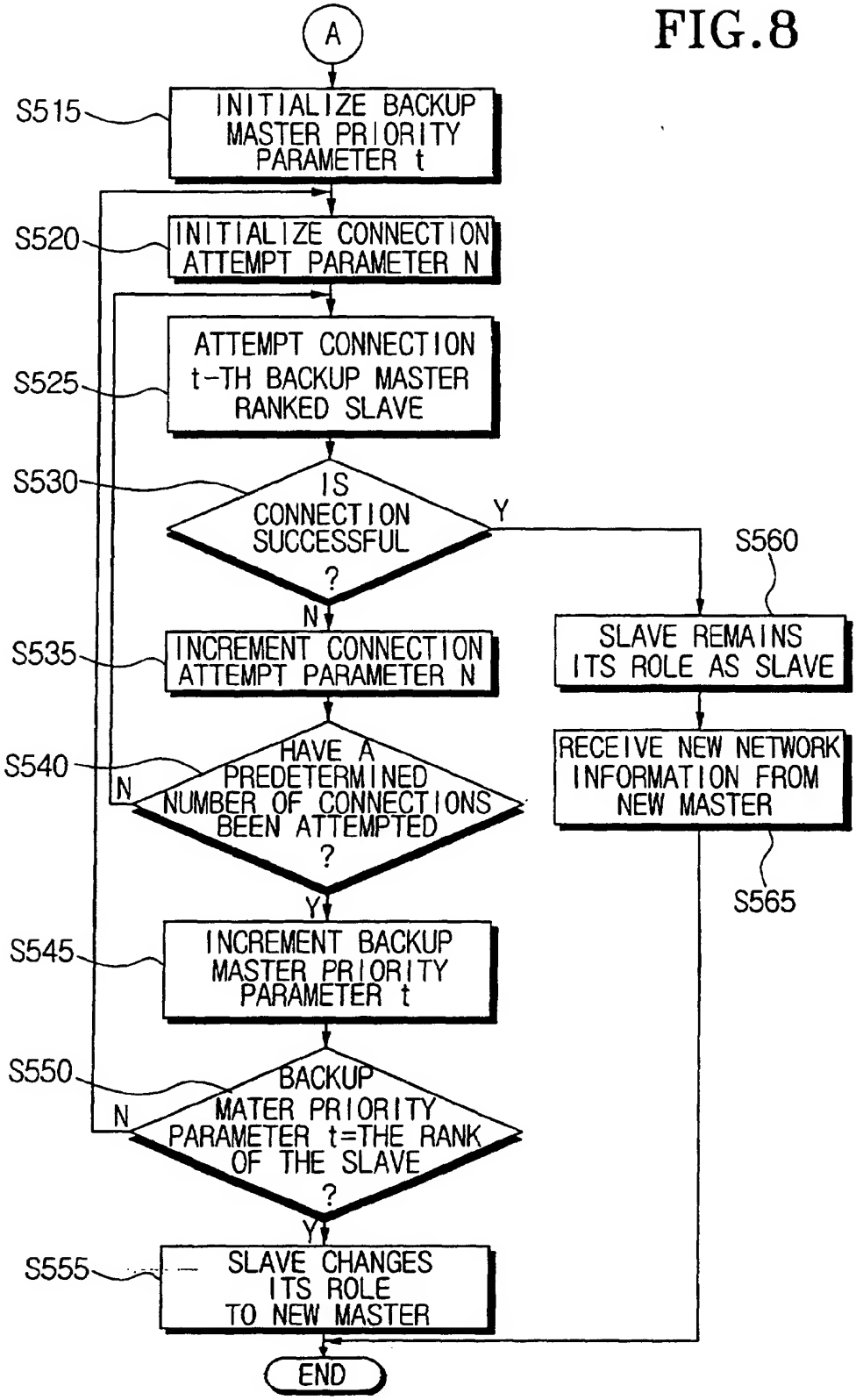

A
S515
INITIALIZE BACKUP MASTER PRIORITY PARAMETER t
S520
INITIALIZE CONNECTION ATTEMPT PARAMETER N
S525
ATTEMPT CONNECTION t-TH BACKUP MASTER RANKED SLAVE
S530
IS CONNECTION SUCCESSFUL ?
Y
N
S560
SLAVE REMAINS ITS ROLE AS SLAVE
S535
INCREMENT CONNECTION ATTEMPT PARAMETER N
S540
HAVE A PREDETERMINED NUMBER OF CONNECTIONS BEEN ATTEMPTED ?
N
Y
RECEIVE NEW NETWORK INFORMATION FROM NEW MASTER
S565
S545
INCREMENT BACKUP MASTER PRIORITY PARAMETER t
S550
BACKUP MATER PRIORITY PARAMETER t=THE RANK OF THE SLAVE ?
N
Y
S555
SLAVE CHANGES ITS ROLE TO NEW MASTER
END

FIG.9

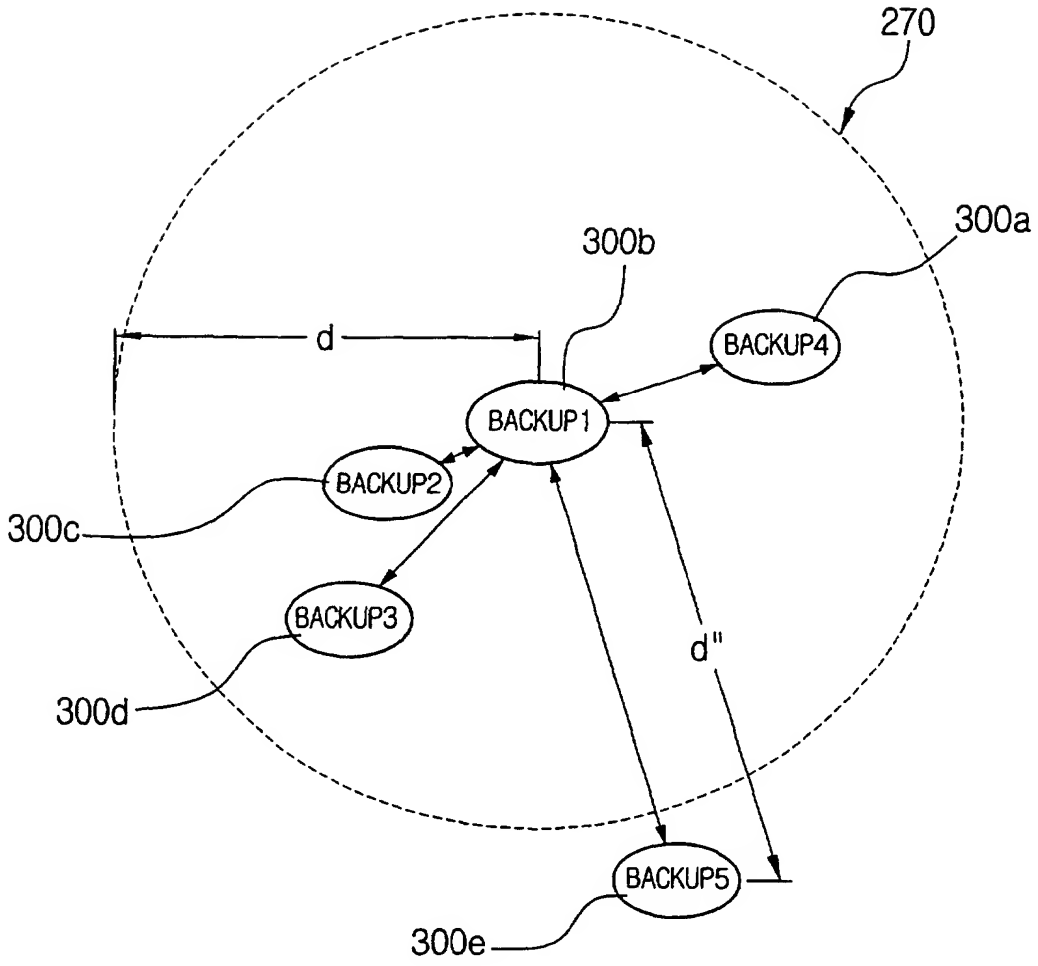

270
300a
300b
d
BACKUP4
BACKUP1
BACKUP2
300c
BACKUP3
d"
300d
BACKUP5
300e

FIG.10

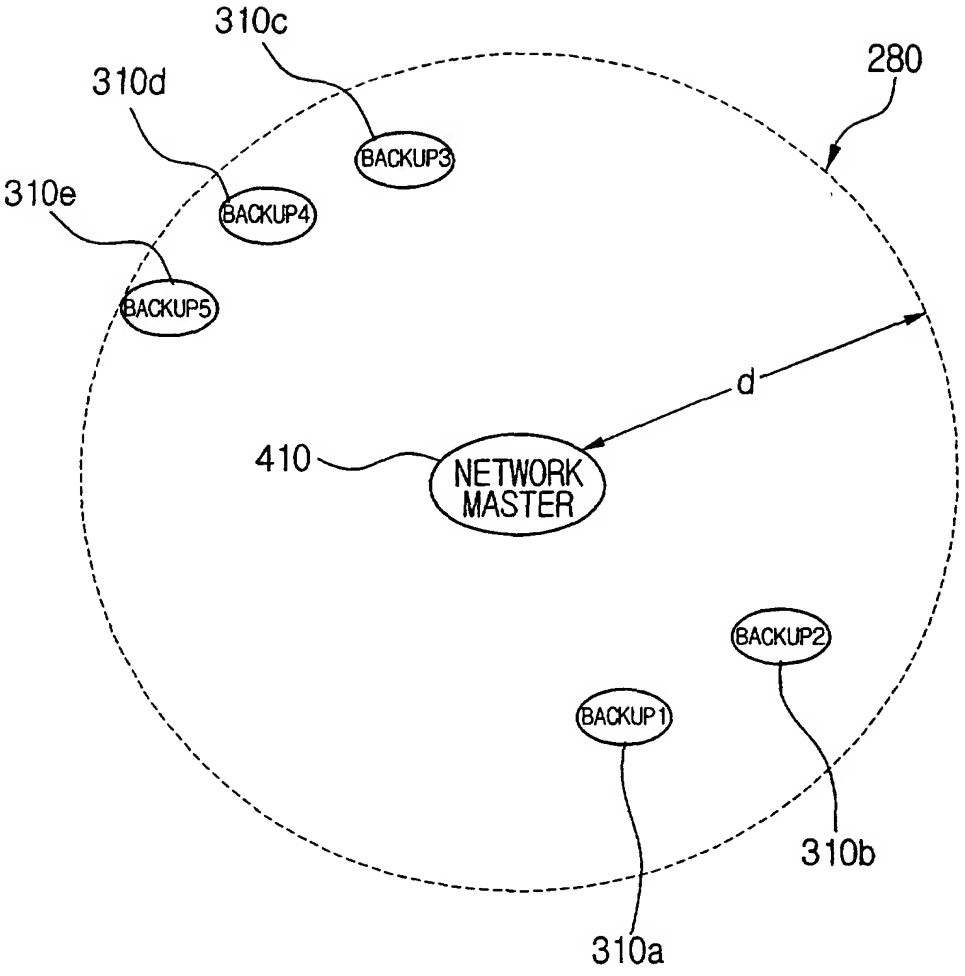
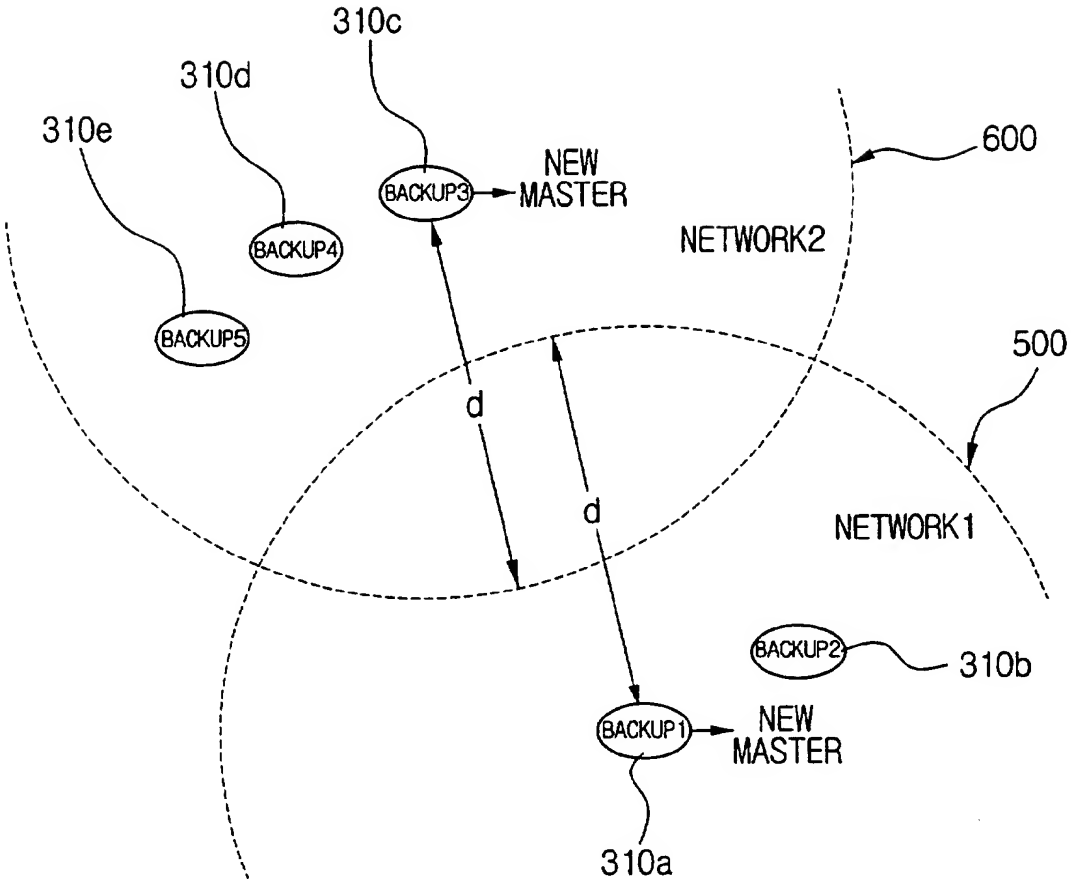

310c
280
310d
BACKUP3
310e
BACKUP4
BACKUP5
d
410
NETWORK MASTER
BACKUP2
BACKUP1
310b
310a

FIG.11


310c
310d
310e
BACKUP3
NEW
MASTER
BACKUP4
BACKUP5
600
NETWORK2
500
d
d
NETWORK1
BACKUP2
310b
BACKUP1
NEW
MASTER
310a